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ABSTRACT

This booklet provides information to parents, students, teachers, and community members about the new mathematics curriculum in western Canada that was developed as a result of the Common Curriculum Framework for K-12 Mathematics. The curriculum represents a dynamic approach to mathematics with problem solving as the main focus for all grade levels, and is the basis for mathematics programs of study in Alberta. This booklet describes some of the knowledge, skills, and attitudes students are expected to learn; some ways parents and other adults can support student learning in mathematics; the goals of classroom instruction and the broad content areas in the curriculum; bridges and connections and how they are built; problem solving techniques; new instructional strategies; and a picture of a modern mathematics lesson. (DDR)

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ED 408 162

Working Together in Mathematics Education

Parents
Students Teachers Community Members

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"Learning for Tomorrow" Curriculum Standards

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Alberta

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This booklet is also available for viewing and downloading from the Alberta Education web site, under the section **Parents**, at: **http://ednet.edc.gov.ab.ca.**

The primary intended audience for this document is:

Administrators	
Counsellors	
General Audience	
Parents	✓
Students	
Teachers	

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Signing of the Western Canadian Protocol for Collaboration in Basic Education

The signing of the *Western Canadian Protocol for Collaboration in Basic Education Kindergarten to Grade 12* in 1993 marked the beginning of joint development projects in education for the four western provinces and two territories. The completion of *The Common Curriculum Framework for K–12 Mathematics* is the first project completed under this agreement. It represents a dynamic approach to mathematics with problem solving as the focus for all grade levels and is the basis for mathematics programs of study in Alberta.

To achieve the goals for mathematics education outlined here, and to encourage lifelong learning in mathematics, students need to be able to solve increasingly complex problems arising in everyday life and to communicate effectively, using the language of mathematics. In solving problems, students expand their knowledge of basic concepts and develop their skills in mental mathematics and estimation, reasoning, visualization and the use of technology. The use of these skills is not limited to the traditional field of mathematics, but is vital to everyday living in our modern society. Also, the changing nature of work, including globalization and advances in the area of technology, have made numeracy skills a basic requirement for everyone.

The Common Curriculum Framework for K–12 Mathematics will help ensure that Alberta students meet the same high expectations as all students throughout western Canada, increasing the opportunities available to them as individuals in striving for self-fulfillment and in serving as the leaders who will take us into the 21st century.

Western Canadian Protocol for Collaboration in Basic Education

Dear Parents, Students, Teachers and Community Members:

Along with reading and writing, mathematics is basic to education. Building students' math skills is a fundamental objective of our education system.

The Common Curriculum Framework for K–12 Mathematics will improve the quality of mathematics learning in our schools. This curriculum was developed by, and is shared among, all four western provinces and the two territories. In addition to improving learning, the common curriculum will make it easier for students to move from school to school throughout western Canada without jeopardizing their progress in mathematics. In Alberta, this curriculum will be implemented in grades 7 and 9 in the fall of 1996, and in Kindergarten to Grade 6 and Grade 8 in the fall of 1997.

This booklet provides an overview of the new mathematics curriculum and shows some of the knowledge, skills and attitudes students are expected to learn. It presents some ways parents and others can support student learning in mathematics. Other curriculum handbooks are available for more grade-specific expectations.

By working together, we can make sure all children learn the mathematical skills they need. It is a simple equation: Parents + teachers + the new mathematics curriculum + student effort + community support = improved student learning!

Gary G. Mar, Q.C.
Minister of Education

Why is it important for our children to study mathematics?

Mathematics Is Much More Than Arithmetic (+ − x ÷) . . .

Mathematics Is . . .

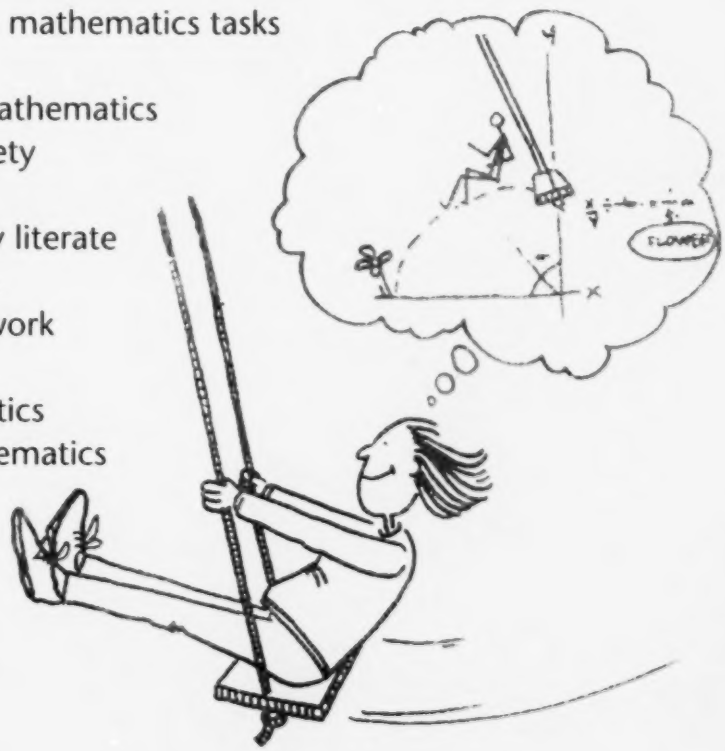
- a useful tool in everyday life
- a language
- the study of patterns and relationships
- a way of thinking
- a positive attitude
- an art

Students Who Are Successful in Mathematics . . .

- are not only competent in arithmetic but also in a wide variety of mathematical skills
- have more self-confidence in problem-solving situations
- are better prepared to make informed decisions
- are more capable of processing information
- are more competent at understanding the world around them
- have many more career opportunities open to them
- can apply mathematical processes to many areas of their life and work
- appreciate the value of mathematics as a useful tool in everyday living
- are better prepared to live in a world of changing technology

What are our goals for students in their study of mathematics?

- to use mathematics confidently to solve problems
- to be able to "stick to" a mathematics task and not give up when seeking solutions
- to have a positive attitude toward mathematics
- to be creative when doing mathematics tasks
- to appreciate and value mathematics and its importance in society
- to become mathematically literate adults, using mathematics successfully in life and in work
- to participate in mathematics discussions, and use mathematics language to reason and communicate
- to experience satisfaction when doing mathematics



What will students study in mathematics?

The content of the new curriculum is divided into the *four strands* shown below. Traditionally, in many mathematics classes, much of the time has been spent on knowledge and skills in the Number strand. Students have learned numbers and how to compute them (adding, subtracting, multiplying, dividing).

In the common curriculum, the other three strands are given equal importance. All students, regardless of ability, will find an area of mathematics learning in which they can "shine" and achieve. For example, a teacher once described how a student who struggled with number work found great satisfaction in working with 3-dimensional objects and became the class "expert" on them.

In planning out the year, teachers will include content from all *four strands*. In this way each student will have an opportunity to "shine" and experience success as they receive a well-rounded mathematics education.

Number

- number concepts
- number operations

Patterns and Relations

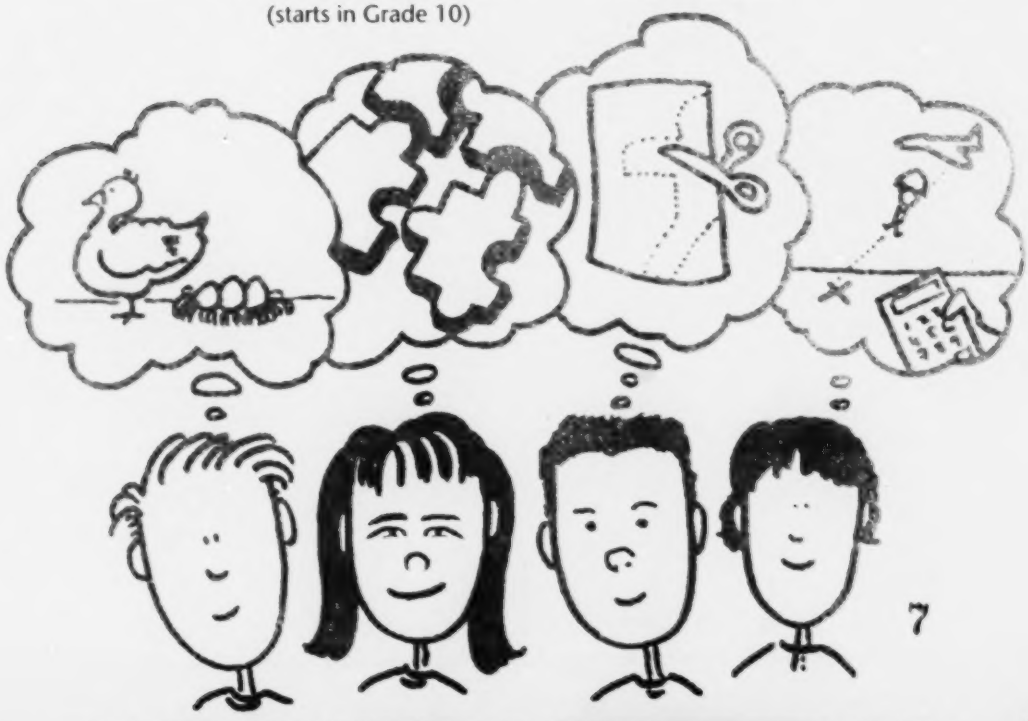
- patterns
- variables and equations (starts in Grade 6)
- relations and functions (starts in Grade 10)

Shape and Space

- measurement
- 3-D objects and 2-D shapes
- transformations

Statistics and Probability

- data analysis
- chance and uncertainty



In order to help children achieve success in mathematics, it is important to create *learning bridges*. These are activities designed to allow students to make *connections* between everyday experiences (concrete materials) and abstract, symbolic thinking.

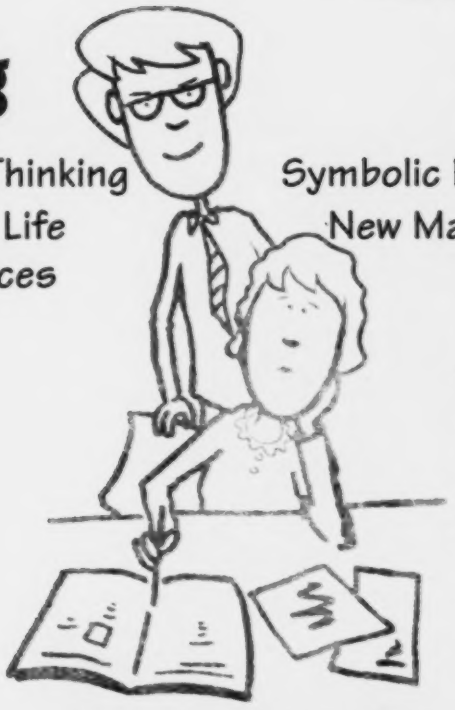
Mathematics is made meaningful and much easier to understand when there are many *connections* made between the two levels of thinking (concrete and abstract). *Learning bridges* are essential. There should be many crossings, back and forth, throughout the grades.

The challenge for teachers is to provide many opportunities for the students to make these crucial *connections*.

Bridging

Concrete Thinking
Student's Life Experiences

Symbolic Experiences
New Mathematical Concepts



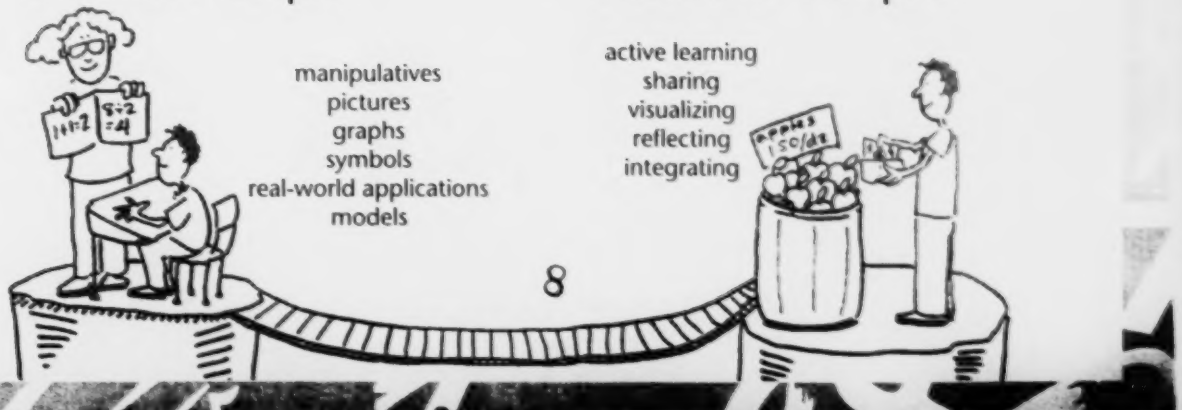
Mathematics Anxiety

- apathy
- uncertainty
- misunderstandings
- frustration
- lack of confidence
- low motivation
- dislike of mathematics
- poor achievement

Connecting

Concrete / Simple

Abstract / Complex



manipulatives
pictures
graphs
symbols
real-world applications
models

active learning
sharing
visualizing
reflecting
integrating

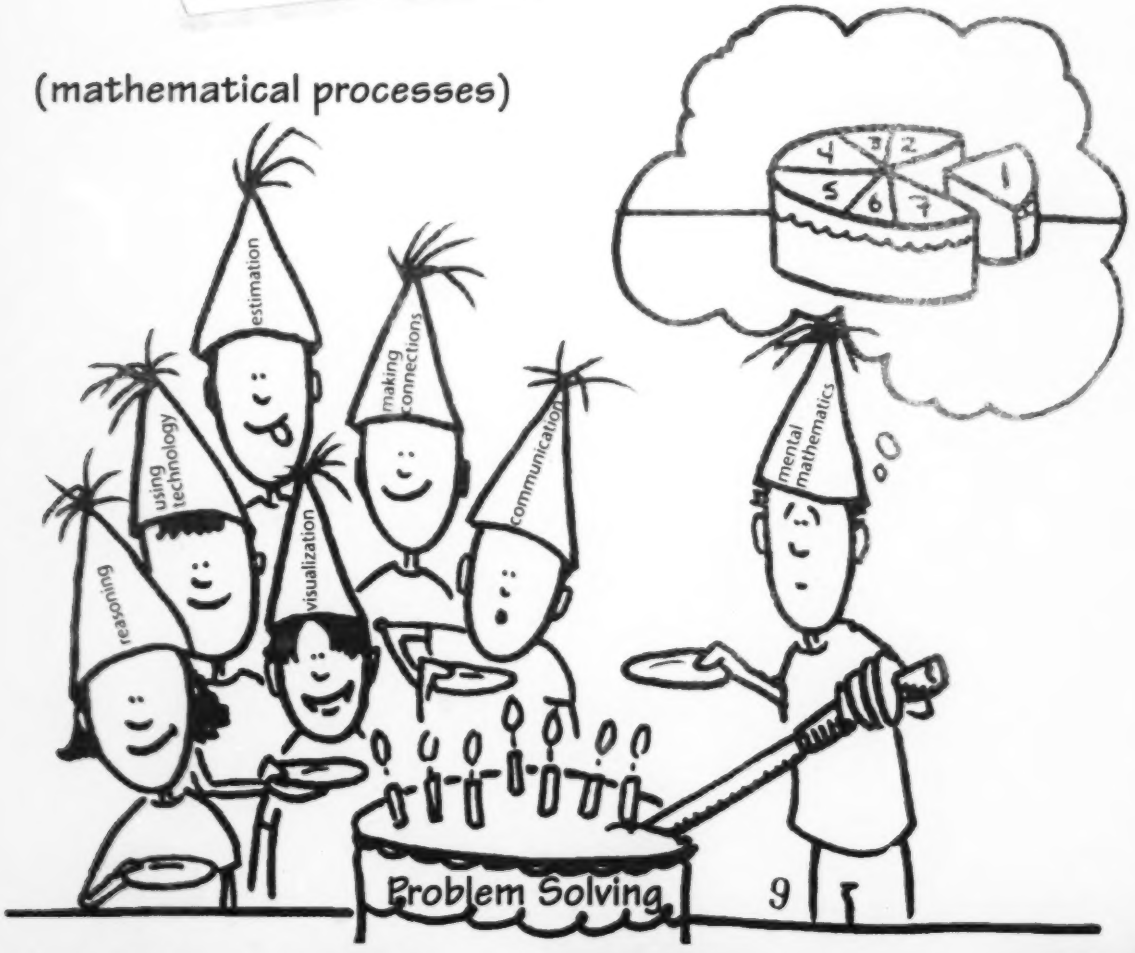
How will students study mathematics?

All learning of mathematics in the new curriculum involves the students using *mathematical processes*. All the processes are interrelated and provide the focus of mathematics education.

In addition to learning sound mathematics, students also will learn how to learn. They will learn how to think. This will improve understanding of mathematical concepts and reduce frustration and anxiety. These *process thinking skills* will serve students well in all areas of their lives. Thinking skills are life skills.

Problem solving is the focus of mathematics at all levels. It provides an opportunity for children to be active in constructing mathematical meaning, to learn problem-solving strategies, to practise a variety of concepts and skills in a meaningful context and to communicate mathematical ideas.

(mathematical processes)



Using the new common curriculum for mathematics:

- *problem* situations can be used to introduce new topics
- the *problem-solving process* is a continuous thread woven through all instruction, in every strand
- *problem* situations can also be used at the end of a unit to check for student success in applying what has been learned about solving problems.

A goal in classrooms is to encourage a *problem-solving "spirit"* in all that is done. Together, students and teachers will experience the satisfaction of working hard toward solving a problem. Together they will become "hooked" on thinking.

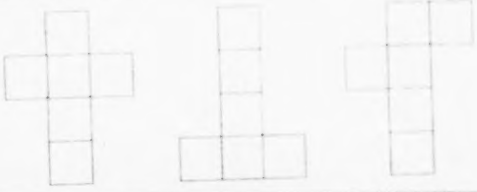
A problem is something to be worked on when you don't know the solution. The solution is not obvious to you. *Problem solving* is the action you take in such a situation.

Many "word problems" in texts are not true problems. They are often just factual mathematical exercises surrounded by words. The only thinking involved is deciding which number operation (+ – x ÷) is needed to solve the problem, then calculating the answer.

For example: Bob had $2. He bought a bottle of pop for $1.25. How much change will Bob get?

Two examples of problems involving more complex and higher level thinking are:

- I have six coins worth $.42. What coins do you think I have? Is there more than one correct answer?
- Cut out each of the following nets (patterns). Fold each one to make an object. What object does each net make? Make a different net for the same object.



Students learn *steps to solving problems*, which help them to organize their thinking.

Make sense of the problem
- understanding what you need to find out.

Attempt several strategies
- what are possible ways of solving the problem?

Solve the problem
- deciding on the best strategy, making a plan, carrying it out.

How did you do?
- looking back, thinking, discussing how the problem was solved.

Students create their own set of problem-solving strategies.

draw a picture or diagram
visualize the problem
organize information on a chart or table
use concrete materials to show the problem
solve a simpler, similar problem
estimate and check
talk out the problem
break down the problem into smaller parts
work backward
look for a pattern
act out the problem (role play)

Math Talk

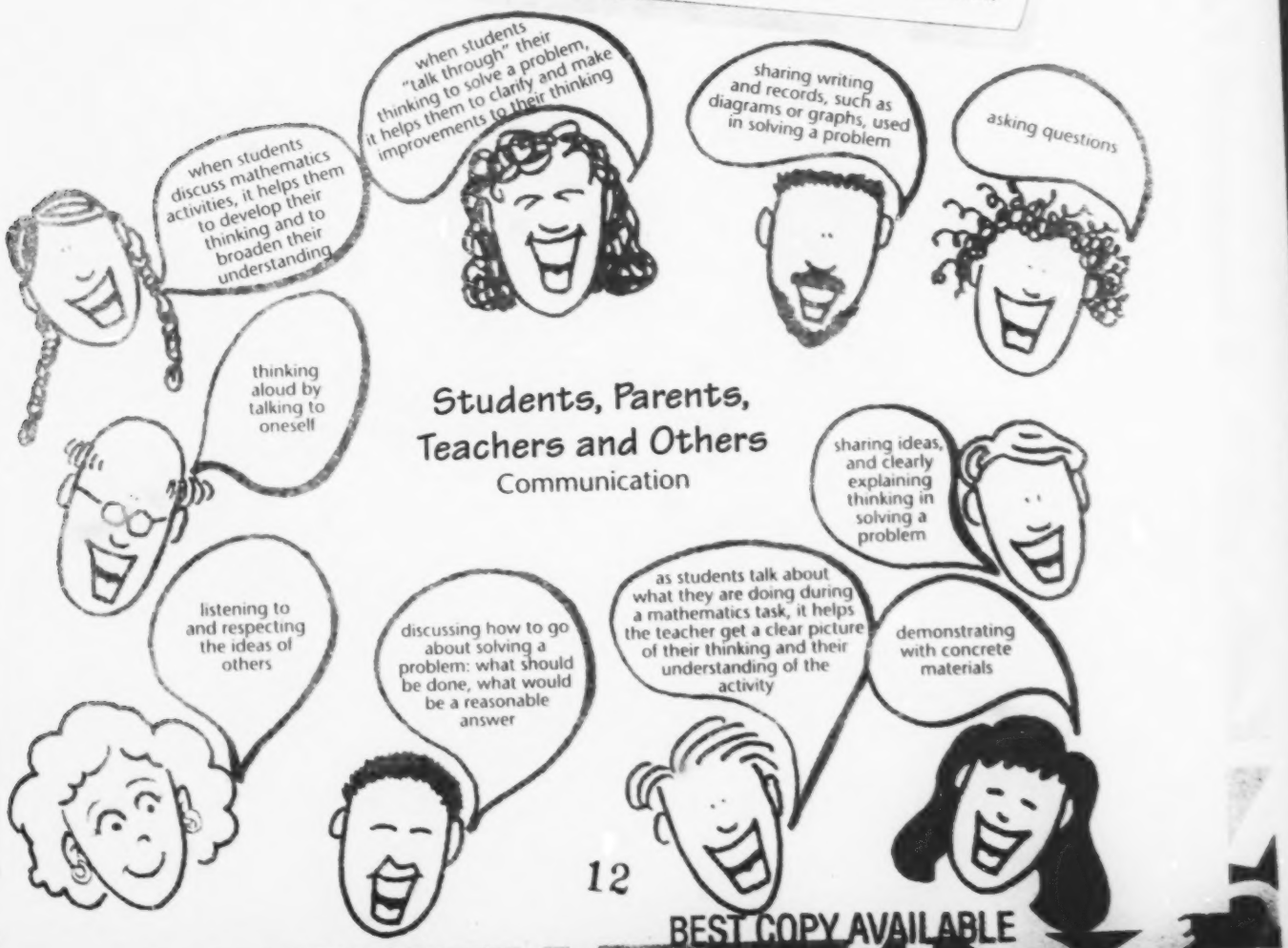
Most of us remember our own mathematics classes as being a very quiet time of the school day. Teachers did most of the talking: explaining a concept, asking questions and giving instructions. Students worked independently and silently at their desks. There was little opportunity for *Math Talk* and student interaction.

The new curriculum recognizes that mathematics is a way to *communicate*. *Communication* is an important mathematical process that should be encouraged in all learning activities.

Students need opportunities to talk to each other about mathematics. They need to feel free to ask questions of the teacher and of their peers. As children are busy doing their mathematics activities, they need to talk about what they are doing, why they are doing it, and what they are learning. When children verbalize their thinking, it helps them to internalize concepts successfully.

Talking about mathematics is not just giving answers to questions like 8 + 6 = ? It's using language to make sense of things. It helps students clarify their ideas. It helps them to connect new concepts to what they already know. It helps them to solve problems.

Teachers, parents and others can encourage *Math Talk*, first and foremost, by being good listeners. When we listen to children talk about how they arrived at particular solutions, we get a picture of how each child is thinking and that child's level of understanding. We can encourage children to explain their ideas clearly. We can help them to organize their ideas by asking questions that focus their thinking. We can ask open-ended questions that promote *Math Talk*.


when students "talk through" their thinking to solve a problem, it helps them to clarify and make improvements to their thinking
sharing writing and records, such as diagrams or graphs, used in solving a problem
asking questions
when students discuss mathematics activities, it helps them to develop their thinking and to broaden their understanding
thinking aloud by talking to oneself
Students, Parents, Teachers and Others
Communication
sharing ideas, and clearly explaining thinking in solving a problem
as students talk about what they are doing during a mathematics task, it helps the teacher get a clear picture of their thinking and their understanding of the activity
demonstrating with concrete materials
listening to and respecting the ideas of others
discussing how to go about solving a problem: what should be done, what would be a reasonable answer

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What might you expect to see in a mathematics class?

Classroom Climate

well-established routines

a community of learners

students motivated and on task

high expectations

positive attitudes

friendly, relaxed, nonthreatening

problem-solving "spirit"

Groupings

- independent activities
- whole class instruction
- teacher-directed groups
- self-directed groups
- learning groups with another class
- small, cooperative groups
- peer partners
- activity centres

Physical Environment

- students' mathematics work on display
- interactive mathematics bulletin boards where students are challenged to solve a problem or create their own "problems"
- manipulatives, models, concrete materials that are used freely by students
- computers and calculators that students use frequently
- mathematics displays throughout the school

Going Beyond the Classroom

- field trips showing mathematics in everyday life, such as to nature parks, places of work, grocery shopping, construction sites
- resource people invited into the classroom to talk about how they use mathematical skills on the job

Technology

Special Events

- Family Math Nights
- Math Club
- Math Fair
- Math Olympics
- Math Summer Camps
- Science Fairs (applying mathematical processes)
- School Events (bake sales, canteens, contests, 100th Day of School, etc.) that involve students applying mathematical skills

Learning Materials

- games, puzzles
- materials collected by students and their families
- manipulatives, models, measuring devices
- objects "found" in the everyday world
- variety of texts, trade books, resource books
- calculators, computers
- teacher-made materials
- commercial materials

6+4=10

How can parents and teachers help children develop a *positive attitude* toward mathematics?

$$\sqrt{16} \quad y^3 \quad 6y + 2 = 20$$

It is very important that you, as parents, be *positive* in your approach when it comes to your child's mathematics education, even if your own experiences with mathematics have not all been positive.

The content of the mathematics curriculum, especially at the higher grades, can seem overwhelming to most adults. But you don't need to know how to do the mathematics yourself before you can help a child.

You can be enthusiastic, encouraging and genuinely interested. You can show that you believe your child can succeed. You can listen carefully. You can praise hard work. You can compliment patience. You can encourage independent thinking. You can reward "sticking to it." You can set a good example yourself by how you solve problems in your own everyday life.

"I can do it."
be positive and encouraging; show you believe that your child can succeed

enthusiastic
be an enthusiastic problem solver yourself

willing to try
help children see that by making progress toward a solution, they are achieving success

willing to stick with it
reward perseverance; set a good example yourself

confident
encourage children to trust their own abilities; don't solve the problem for them

not afraid to make mistakes
help your child see that mistakes are an opportunity for further learning

patient
compliment your child for taking time to think through a problem

finds satisfaction in solving a problem
praise your child for good mathematical thinking

music

- learn to play an instrument, rhythm patterns

newspapers and magazines

- examine surveys, check computations in media (sports pages, advertisements, stock market), how per cent is used in advertising

TV and radio

- estimate hours of TV watched last week, last month, last year

cooking

- adjust a recipe to yield a certain number, measure ingredients (fractions), oven temperature

books

- read books having mathematical content (pattern in story, counting, etc.)

travel

- interpret maps; estimate speeds, distances, how many litres per kilometre; estimate time needed to get from A to B, duration of trip; estimate arrival/departure times

money

- calculate sales, budget, allowance, three video games for $1 (ratio)

construction

- make scale drawings, construct using interlocking toy sets, work together on a small building project or repair job

home decorating

- estimate/measure around the home (perimeter, area, angles); estimate/calculate how much material, costs of projects

sewing

- estimate/measure material, calculate how much material would be needed for a project, estimate/calculate costs

shopping

- calculate discounts, 3 kg for $1.99 (ratio); determine GST (per cent); estimate items in a package—then count; estimate cost of groceries for a week

sports

- determine rate of speed; win/loss per cents; games behind; estimate/measure lengths, heights, distances; understand and compute batting averages

Parents can help their children see the value of mathematics as a way of understanding the world around them. They can show children that "Mathematics Is Everywhere!" They can provide experiences for children to apply skills learned at school to everyday situations at home.

A sample of activities is included here to give you an idea of some of the possibilities. By extending mathematics learning from the classroom into everyday life, children will come to appreciate mathematics as meaningful and important in our world.

weather

- measure hours of daylight, temperatures, rainfall; calculate averages

time

- estimate length of time, one-minute challenges (kitchen timer); estimate how many *(???)* you could do in a minute, day, month, year

games

- participate in card games, puzzles, logic games, board games

collections and hobbies

- collect, sort, sequence, compare, extend/create patterns; estimate number (buttons, shells, rocks, stamps, cards, etc.); estimate measurement

It makes a great difference to the success of students when what needs to be learned is clearly communicated to them.

Throughout the school year, parents and teachers need to keep in touch. There should be regular school–home communications and homework assignments that encourage "family mathematics." There should be many special events throughout the year that will allow parents and others to see what's going on at school. And there is always an open invitation to drop in and join a mathematics class!

How can parents *support* their child in school?

Make it a habit to talk with your child about school work. Even if you aren't familiar with the topic, you can still be an interested listener.
Be available to provide help and support, if it is needed. If you are unable to help, then assist your child in finding someone who can.
Work with your child to set up a study area in the home that is comfortable and away from too many distractions.
A regular study time should be established when homework assignments, review work or reading are to be done. Negotiate a time that is flexible enough to fit into your child's extracurricular schedule.
Make sure your child has a good night's sleep, eats breakfast and gets to school on time every day.
Keep in touch with your child's teacher. Stay informed about your child's progress (notes, telephone calls, visits). Encourage the teacher to contact you about successes and achievements, not just concerns.
Attend parent orientation nights, open houses, special events, parent–teacher interviews. Read school newsletters. Discuss all of these activities with your child.
Make sure your child has access to scraps and materials for building, constructing and making things.
Invite your child to watch or assist you whenever possible. It is an excellent way for a child to build up background experience and to build self-confidence in trying new things.
Have fun with problem solving on a regular basis at home. Use your child's experiences and everyday situations to create and solve problems.